Sections 2.1 and 2.2

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"You don't learn to walk by following rules. You learn by doing, and by falling over."

- Richard Branson

Historically, the average claim size for residential home damage from a hurricane is $25,300. Hurricane Andrew swept through southern Florida causing billions of dollars in home damage. Because of the severity of the storm and the type of residential construction used in this semi-tropical area, there was concern that the average claim size would be greater than the historical average. Several insurance companies collaborated in a data gathering experiment. They randomly selected 45 homes and found that the average claim for the 45 homes was $26,500 with a standard deviation of $6635. Is there good evidence that the average claim for home damage from Hurricane Andrew was greater than the historical average?

(1) What are the observational units?

A Dollar amounts of the claims

B Homes damaged by all hurricanes

C Hurricanes in residential areas

D Insurance claims for home damage due to Andrew

E Insurance companies that cover home damage

(2) What is the variable of interest?

A The dollar amount of the claims.

B The average claim size for Hurricane Andrew.

C The proportion of homes damaged by Hurricane Andrew.

D If claims for home damage were greater for Hurricane Andrew.

E Whether or not a home was damaged by Hurricane Andrew.

Historically, the average claim size for residential home damage from a hurricane is \$25,300. Hurricane Andrew swept …

(3) Is the value \$25,300 above a hypothesized parameter value or a statistic?

A Hypothesized parameter value

B Statistic

C Both

D Neither

E I am not sure

... Several insurance companies collaborated in a data gathering experiment. They randomly selected 45 homes and found that the average claim for the 45 homes was $26,500 with a standard deviation of $6635.

(4) Is the value $26,500 above a parameter or a statistic? What symbol do we use for numbers like this?

A Parameter, μ

B Parameter, $\overline{x}$

C Statistic, $\hat{p}$

D Statistic, t

E Statistic, $\overline{x}$

Historically, the average claim size for residential home damage from a hurricane is \$25,300. Hurricane Andrew swept through ... the average claim for the 45 homes was \$26,500 with a standard deviation of \$6635. Is there good evidence that the average claim for home damage from Hurricane Andrew was greater than the historical average?

(5) What is the null hypothesis?

- A The long run probability that a home was damaged by Hurricane Andrew is no different than the historical probability.
- B $H_0 : \pi = \$25{,}300$
- C $H_0 : \mu = \$26{,}500$
- D The mean claim for home damage from Hurricane Andrew is no different than the historical average.
- E $H_a : \overline{x} > \$25{,}300$

Historically, the average claim size for residential home damage from a hurricane is \$25,300. Hurricane Andrew swept through ... the average claim for the 45 homes was \$26,500 with a standard deviation of \$6635. Is there good evidence that the average claim for home damage from Hurricane Andrew was greater than the historical average?

(6) What is wrong with the following alternative hypothesis?
$H_a : \pi \neq \$26{,}500$

A The parameter is a mean not a proportion.

B The research question suggests a right–tailed, not two–tailed alternative.

C Hypothesized parameter values, not the values of statistics, should appear in the hypotheses.

D All of the above.

E B and C, but not A.

(7) Given the test statistic $t = 1.21$ for Hurricane Andrew claims, what sort of p–value would you expect for this study? The p–value would be

- A very small, claims for Andrew were 1.21 times larger than the historical average.
- B very small, Andrew's claims were \$1200 above the historical average.
- C small to moderate, $\overline{x}$ is only 1.21 SEs above the historical average.
- D moderate to large, $t = 1.21$ gives little to no evidence against H_0.
- E large, 26,500-25,300 $= 1200$ is very small compared to $s = 6635$.

A zoologist at a large metropolitan zoo is concerned about a potential new disease present among the 243 sharks living in the large aquarium at the zoo. The zoologist takes a random sample of 15 sharks from the aquarium, temporarily removes the sharks from the tank and tests them for the disease. He finds that 3 of the sharks have the disease.

(8) Is it reasonable to assume that the sample of 15 sharks is a good representation of all 243 sharks in the aquarium?

A No, 15 is too small of a sample for this setting.

B No, the population is not 20 times the sample size.

C No, a larger convenience sample would be more representative.

D Yes, the sample was random.

E Yes, the population is more than 10 times the sample size.

(9) Recall that the zoologist found $3/15 = 20\%$ of the sharks in the sample with the disease. If he wanted to test if less than 1/4 of the sharks in the aquarium had the disease, what is his null hypothesis?

A $H_0 = 0.25$

B $H_0 : \mu = 0.2$

C $H_0 : \pi = 0.25$

D $H_0 : \hat{p} < 0.25$

E $H_0 : \overline{x} = 3/15$

(10) A simulation based p–value for this test is $p = 0.48$. Which of the following are correct conclusions based on this p–value?

A We have good evidence that $\pi = 0.25$.

B We do not have good evidence that $\pi < 0.25$.

C 0.25 is one of many plausible values for π.

D A and B but not C.

E B and C but not A.

(11) A simulation based p–value for this test is $p = 0.48$. Which of the following are correct statements about this p–value?

A When $\pi = .25$, random samples of size 15 will have $\hat{p} \leq \frac{3}{15}$ about 48% of the time.

B The sample must have been biased because $\hat{p} < 0.25$, so we should have a small p–value.

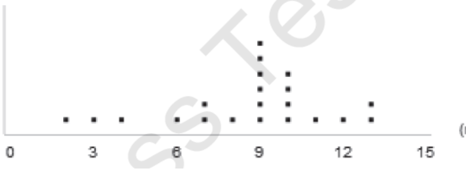
C The simulation must have been done wrong, the p–value should be smaller.

D If we took a larger sample ($n > 15$), but still had $\hat{p} = 0.2$, the p–value would be larger.

E If the population size were doubled (486 sharks in the aquarium), but everything else stayed the same, the p–value would decrease.

(12) Here is a dot plot for the ages of 21 male rattlesnakes captured at a single site. Assume that these 21 snakes can be regarded as a random sample of all male rattlesnakes at that site. The average age is 8.571 years, with a standard deviation of 2.942 years. Describe the shape of this distribution.

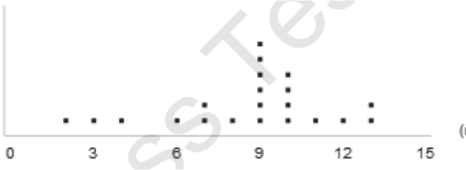
A skewed left
B slightly skewed left
C fairly symmetric
D slightly skewed right
E skewed right



(13) Based on the dot plot of rattlesnake ages below, how would you expect the median to compare to the mean?

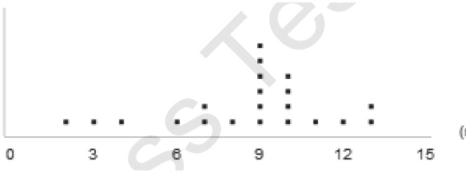
The median would be

- A less than the mean
- B roughly equal to the mean
- C greater than the mean
- D You cannot tell

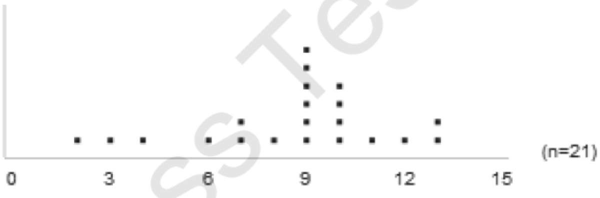


(14) Based on the dot plot of rattlesnake ages below, estimate the value of the median

A 7
B 8
C 9
D 11
E You cannot tell



(15) If the ages of the three youngest rattlesnakes were all changed to 0, what would happen to the SD?



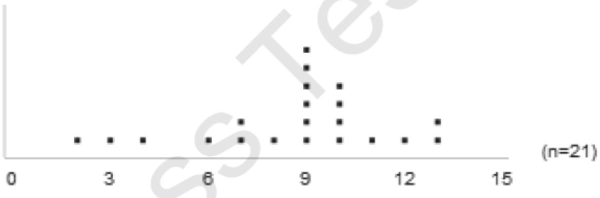
A It would get smaller

B It would not change

C It would get larger

D You cannot tell

(16) If the ages of the three youngest rattlesnakes were all changed to 0, what would happen to the mean?



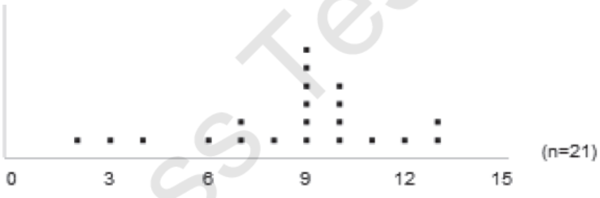
A It would get smaller

B It would not change

C It would get larger

D You cannot tell

(17) If the ages of the three youngest rattlesnakes were all changed to 0, what would happen to the median?



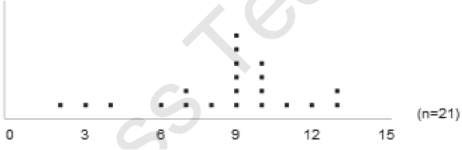
A It would get smaller

B It would not change

C It would get larger

D You cannot tell

(18) For the 21 rattlesnakes, the mean age was 8.571 years with $s = 2.942$ years. Which of the following calculations do you feel gives the best measure of how rare a 12.5 year old rattlesnake would be at this location?



A It is the 3rd oldest rattlesnake.

B It is $12.5 - 8.571 \approx 3.9$ years above average.

C It is approximately $\frac{12.5}{2.942} \approx 4.2$ SEs above zero.

D It's approximate standardized value is $\frac{12.5-8.571}{2.942} \approx 1.34$.

Key Terms and Ideas to Understand in Section 2.3

- Significance level
- Type I error (false alarm)
- Type II error (missed opportunity)
- Power of a test